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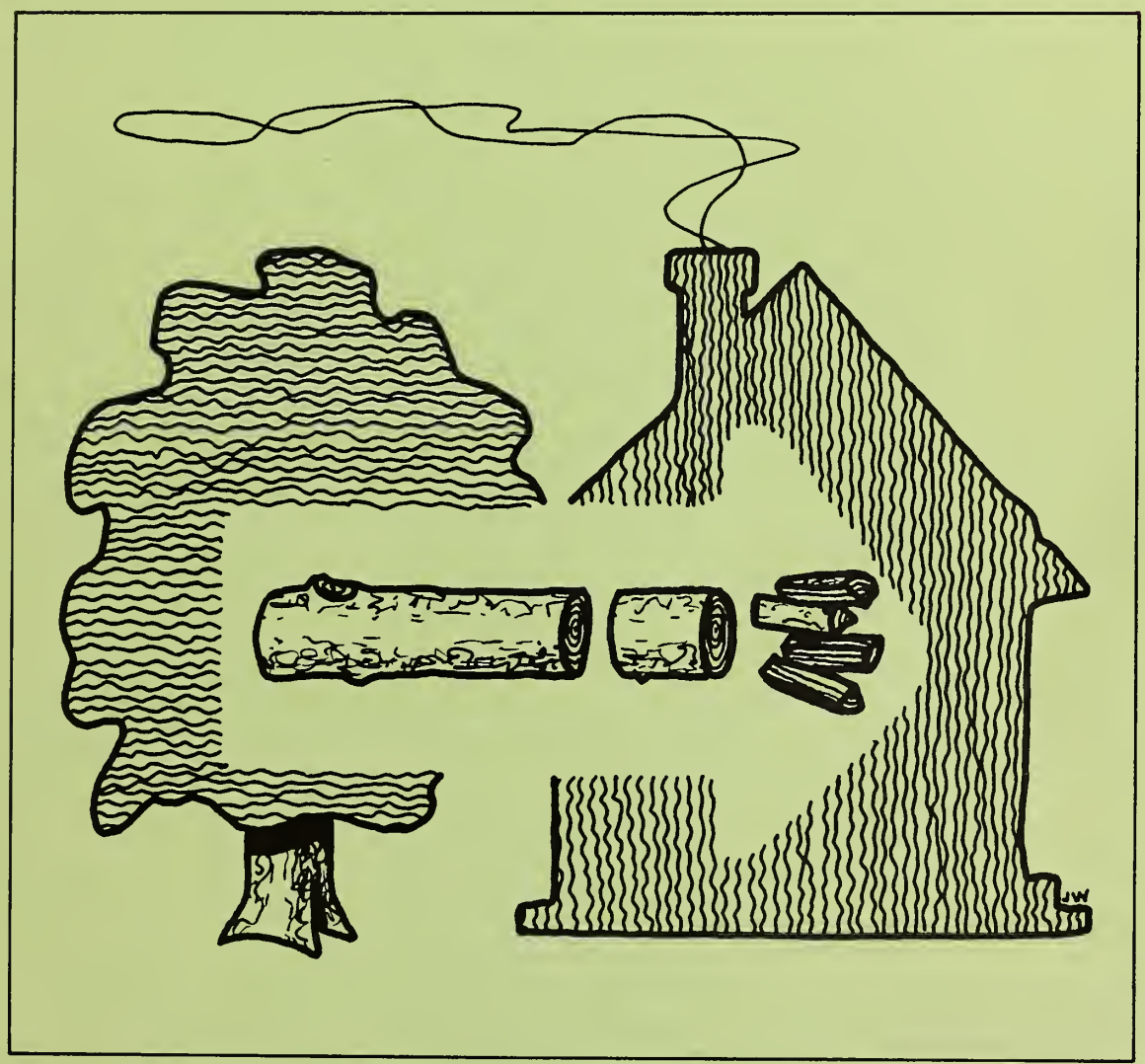
PROSPECTUS: Firewood Manufacturing and Marketing



THE AUTHORS

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ABSTRACT

Three mechanized firewood processing systems were timed to give production data on 750 logs. Raw material procurement, labor requirements, production rates, and nonproductive time are discussed. From market survey data, production information, and company records, a hypothetical production scheme was developed to assess the investment potential of manufacturing and marketing firewood. The profit from the investment required in firewood manufacturing is better than interest from a government bond yielding 11 percent annually as long as nonproductive time does not exceed 15 percent.

CONTENTS

INTRODUCTION

Questionable energy availability and sharply rising energy costs have created much interest in alternative fuels. Since 1973 the interest in using wood as an alternative fuel has led to a tenfold increase in annual sales of wood-burning appliances--currently 1-1/2 million units.[1/] The resulting demand for firewood has generated many inquiries to the USDA Forest Service and state forestry agencies about the requirements for entering the firewood manufacturing business. Can one make money in such a venture? What are the operating costs? More important, what about markets?

This report examines the potential of entering the firewood business on a commercial scale. We wanted to find the most automated firewood manufacturing system on the market, study it under actual production conditions, and then construct a hypothetical firewood processing plant showing all economic implications of the venture.

[1/] Shapiro, Andrew. 1979. Formerly with the Wood Energy Institute.

TIME STUDY

The firewood processor selected was the LaFont[2/] machine (Fig. 1). Three operations, one in the Lake States, another in the Mid-Atlantic region, and a third in the Central United States, were analyzed. A brief description of each company follows:

Company A

A three-man operation with a single splitter processed primarily red oak. The work force consisted of the sawyer, yardman, and splitter. Pulpwood-size logs were purchased according to rigid length specifications, 9 feet 10 inches long or multiples thereof. All firewood was sold bulk.

Company B

A four-man operation with a double splitter processed primarily red and white oaks plus a small amount of maple. This company did its own logging, bringing in wood from land clearings and logging residue left after sawlog harvests. All firewood was sold bulk.

Company C

A seven-man operation using a double splitter produced primarily maple and birch. Pulpwood-size logs were either purchased or cut by the company's own logging crew. Bulk and packaged firewood were sold. Packaged firewood was palletized in one-third cord units.

The machine analyzed consisted of an automated log deck feeding logs 8 to 10 feet long to a unique carriage, capable of advancing even crooked logs, through a manual or automatic bucking unit. The logs were reduced to firewood bolts of predetermined length--normally 16 inches. The bolts were then elevated by conveyor to one or two splitters. Each operation studied had a different means of removing and handling split wood. One used conveyors, another allowed the split wood to accumulate in a bin, and one allowed the wood to fall in a pit under the splitter.

[2/] The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture or the Forest Service of any product or service to the exclusion of others that may be suitable.

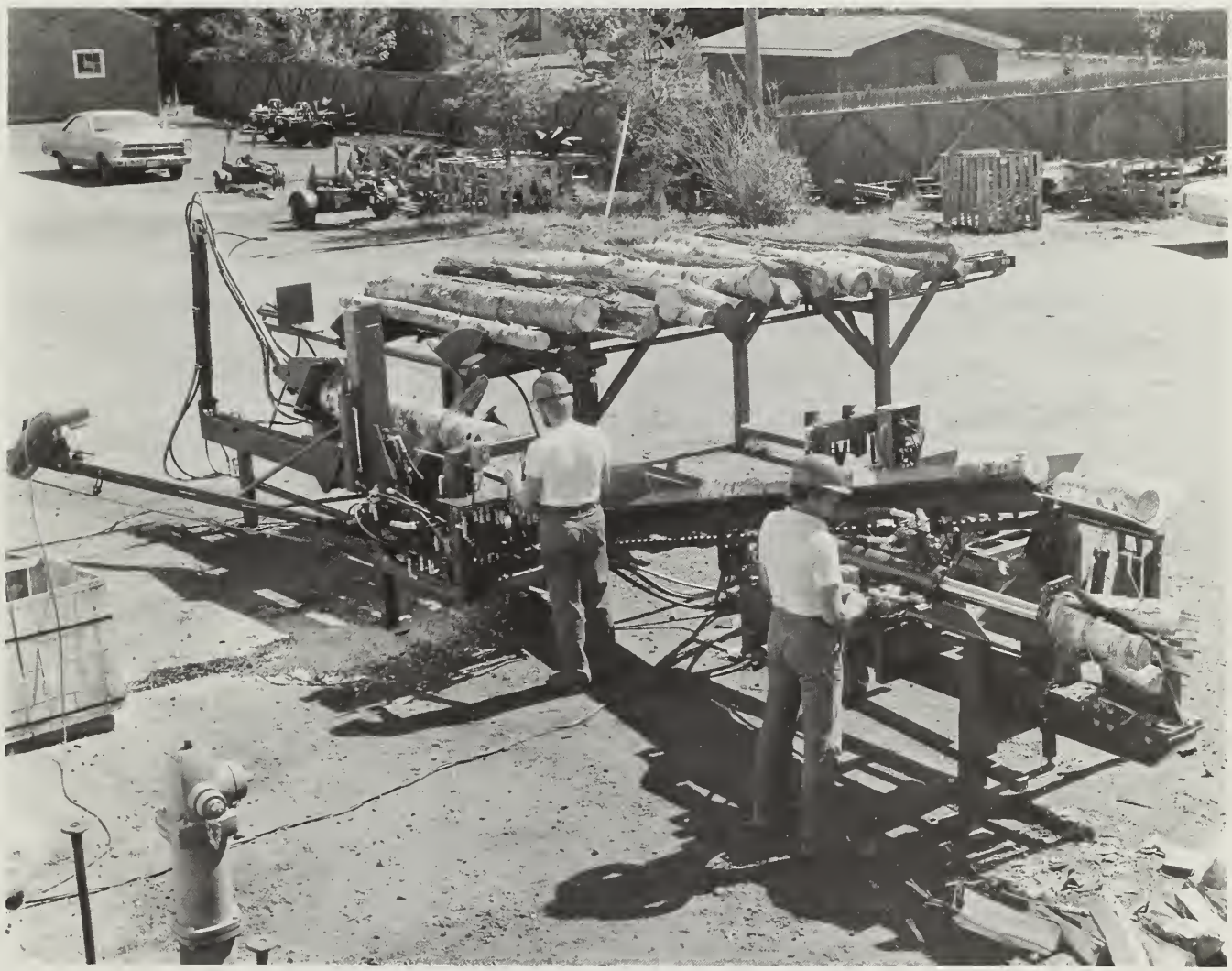

Figure 1 - LaFont firewood processor

TIME STUDY PROCEDURE

The procedure used in analyzing each plant was identical. The average small end and large end diameters inside bark and log length were recorded for each log processed. Cubic-foot contents of solid wood in each log were computed using Smalian's formula. We used a conversion factor of 80 cubic feet of solid wood per cord. Measurement of log length and diameter determined the gross volume coming into the plant.

The bucking and splitting elements of each operation were timed. The bucking cycle began and ended when each log first touched the carriage. The splitting cycle began and ended when each log first touched the splitter feed conveyor. Any downtime greater than 10 seconds was recorded as nonproductive time, with note of the reason. A total of 750 logs were timed at the three plants.

Processing times, production rates, and labor requirements were based solely on the production of bulk firewood. In the case of Company C, where both bulk and packaged firewood were produced, our analysis was based on a crew of six rather than seven. One man was charged to the packaging operation.

TIME STUDY RESULTS

Raw material procurement

For all species and companies, 1.06 cords of raw material (log purchased) were required to produce a cord of split firewood. There were two types of volume loss during processing. In producing 16-inch firewood bolts, 2 percent of the input volume was lost as sawdust. Additionally, waste was generated in the form of trim cuts or irregular-length pieces; this type of loss was termed offal and was calculated using the formula for volume of a cylinder. Thus, the net volume of useable firewood produced by each plant was gross volume less sawdust and offal volume.

In terms of firewood recovery from log input, a clear advantage belonged to Company A (Table 1) due in large part to its log specifications. Adherence to these specifications had a significant impact on production since offal volume was nil, thereby reducing the raw material cost per finished cord of product.

Losses tended to increase in the lower and upper diameter limits of the study logs, probably due to crook and fluted butt cuts (Table 2). Table 2 also shows the distribution of study logs.

Firewood production rates

Table 3 presents the actual production rates in cords per hour and cords per 8-hour shift, by company. There was never an instance when the splitters, either double or single, could not keep up with the bucking unit. Once the bucking unit stops, production ceases. Therefore, overall efficiency is based to a large degree on keeping the bucking unit operating.

Figure 2 shows the processing time per cord of firewood related to diameter. Ninety-six percent of the logs were smaller than 11 inches. Processing time decreased and production increased with increasing diameter over the entire range of diameters. Somewhere above a diameter of 14 inches, an increase in processing time per cord can be expected due to the extra time needed to handle larger logs than the machine is designed to handle. A production rate of 2 cords per hour was achieved for logs 10 and 11 inches in diameter. Production rates were significantly lower for smaller diameter logs. The use of small-diameter trees for firewood is laudable environmentally, but a poor choice for efficient production.

Nonproductive time

Table 4 itemizes productive versus nonproductive time for each company. Nonproductive time was broken down into elements as follows:

1. Personal activity: Includes coffee breaks, starting work late, etc.
2. Work not in cycle: Includes shutting down processor to empty bin or pit of split firewood, etc.
3. Equipment breakdown: Self-explanatory.
4. Equipment maintenance: Self-explanatory.
5. Product jam: Resulting from logs falling through deck, saw pinched, etc.
6. Wait for product: Resulting from no logs on deck, etc.
7. Wait for instructions: Self-explanatory.

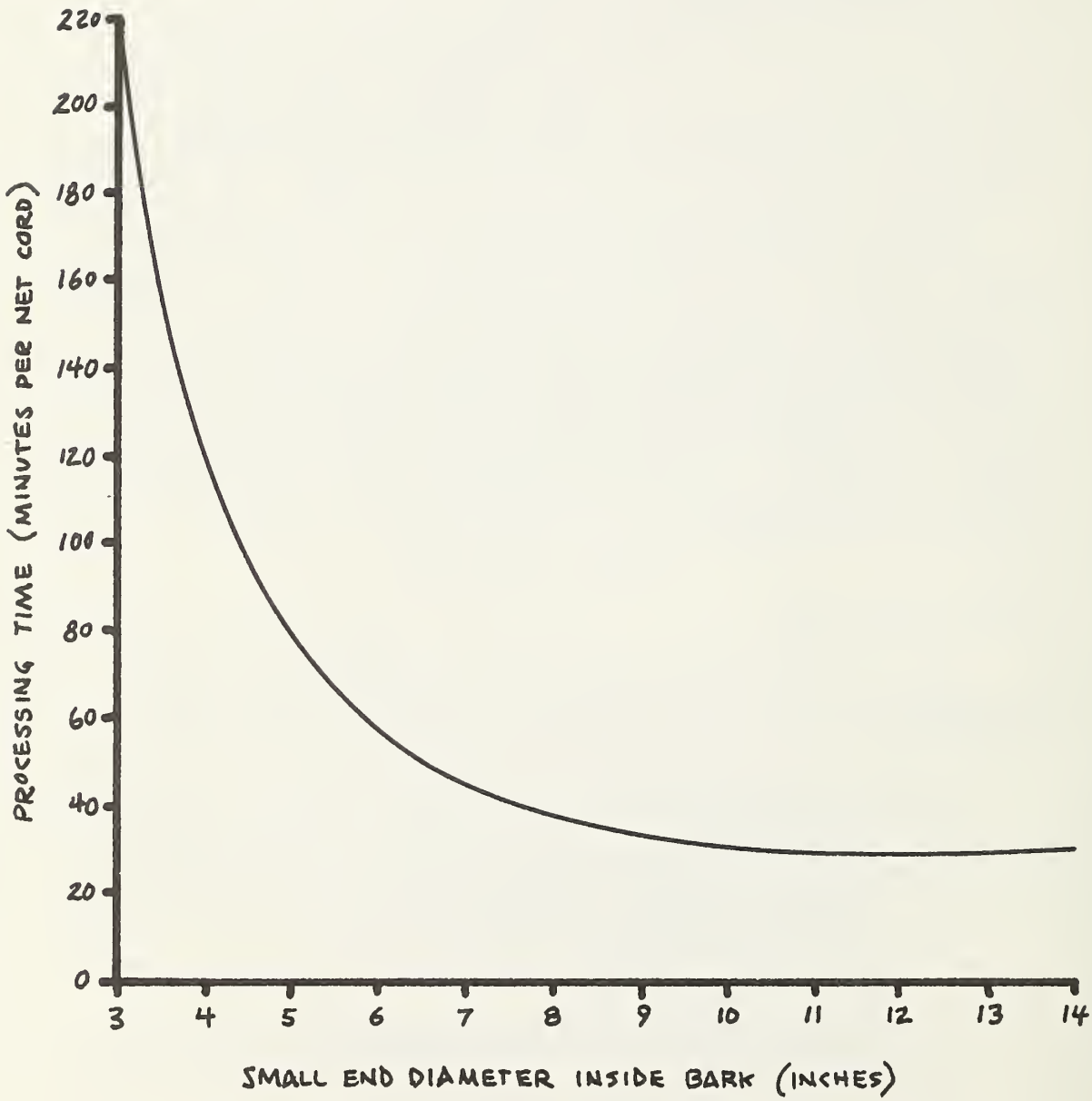

Figure 2 - Firewood processing time related to log diameter; based on 750 logs with an average small end diameter outside bark of 7 inches. The curve includes 38 percent nonproductive time.

Nonproductive time of 36 to 40 percent for these three companies seems excessive, and one has to question the reasons for it (Table 4). The category of "work not in cycle" accounted for 29 percent of total study time for Company B and 21 percent for Company A. Yet Company C had no loss for this reason. It would seem that firms A and B could have reduced this element of nonproductive time by a change in equipment setup or the addition of an employee. "Equipment maintenance" of 12 percent in Company C also seems high because much of the maintenance could have been handled as preventive and, therefore, scheduled before or after working hours or during lunch. The 5 percent of nonproductive time in Company C spent waiting for product also seems unnecessary.

The other elements of nonproductive time seem to fall within acceptable limits. We believe that nonproductive time for the firewood processor should not exceed 15 percent under any circumstances. Further, such a reduction in nonproductive time is anticipated as owners and operators of relatively new equipment gain production experience. Companies B and C had already planned changes in firewood handling systems for the near future.

Labor requirements

Figure 3 relates firewood production to man-hours required for all three firms at three production levels: actual, attainable, and theoretical maximum. Attainable production is a level achieved by reducing nonproductive time to 15 percent, while theoretical maximum production is calculated with no nonproduction time.

The most labor efficient firm was Company A with only 1.8 man-hours of labor per cord of bulk firewood produced. In fact, the operation with the single splitter was more labor efficient and productive than those with the double splitter processor.

MARKET ASSESSMENT

Prospective firewood manufacturers need information about potential markets. Published reports on fuelwood consumption are too nebulous to be of use to a potential investor interested in a specific location. The investor must know who is using firewood, why they are using it, where they are getting it, what they are paying for it, and the type and quantity of wood being used. Then and only then can he make a rational decision regarding investment opportunities in firewood processing.

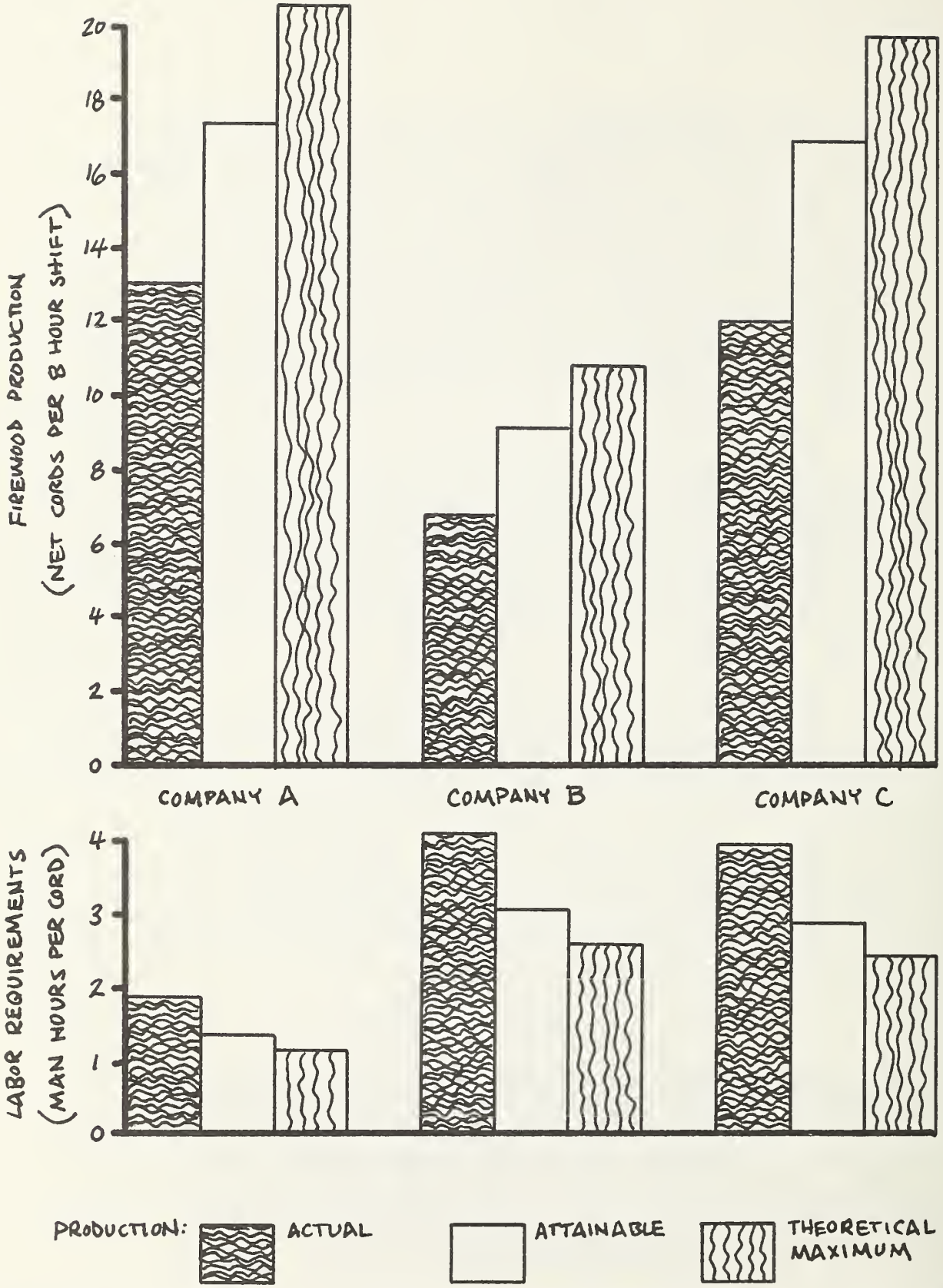

Figure 3 - Actual, attainable, and theoretical maximum production and labor requirements

The Maryland Forest Service and the Minnesota Department of Natural Resources assisted us in providing unpublished data on the firewood markets of Baltimore-Washington and Minneapolis-St. Paul. There are 2,175,000 households in the Baltimore-Washington area and 584,000 in the Minneapolis-St. Paul area. Residents of 157,117 houses or 27 percent of the total households in the metropolitan Twin Cities area used firewood during the 1978-79 heating season (Table 5). In Baltimore-Washington, residents of 364,170 homes or approximately 17 percent of the households used wood during the same season. The total volumes of wood consumed during the winter of 1978-79 in Baltimore-Washington and Minneapolis-St. Paul were 517,857 cords and 228,316 cords, respectively. In other words, the average wood-using household in the Baltimore-Washington area used 1.4 cords per year, and 1.5 cords per year in Minneapolis-St. Paul.

To provide more meaningful figures, firewood users were divided into four user classes. Class 1 users were households that used wood as the major source of heat, Class 2 as a secondary source of heat, and Class 3 for purely esthetic reasons. Class 4 referred to households using wood as a secondary source of heat and for esthetic reasons. Table 5 identifies volumes used by class for each market area.

Consumers either bought wood or cut it themselves. Table 6 tabulates volumes purchased and volumes cut by the consumer and by user class. This information is significant for any entrepreneur who plans to enter the firewood business because it defines the market share potentially available to him. However, it gives no indication of existing competition which, in some cases, can be fatal to new ventures. And although large volumes of wood were consumed in both metropolitan areas, less than a third of the wood was actually purchased.

Table 7 shows consumer preference for firewood species in each market area. Consumers in both areas indicated a preference for mixed hardwoods and oak over other species.

To quantify trends in fuelwood consumption, individuals who currently do not use wood were asked whether they plan to install wood-burning facilities within the next 3 years; and if so, would they install a fireplace, stove, or furnace (Table 8). Based on responses and average firewood consumption per household, fuelwood demand was projected to increase slightly. Such projections, however, are tentative and subject to drastic change due to unforeseen political or economic events which may bear heavily on consumer behavior.

INVESTMENT POTENTIAL

The purpose of this report is to assist potential investors in deciding whether or not to enter firewood manufacturing. Production data and market information have already been discussed. It's now time to put both together in determining the investment potential of the enterprise.

Let's assume that you have $50,000 to invest and require a return exceeding that offered in long-term government securities to make the investment attractive. Long-term government securities provide the highest possible rate of return (11 percent) with minimum risk to the investor. These securities are available in the form of Federal Home Loan bank bonds.

You reside in a Minnesota town that has a population of approximately 200,000 and is near some heavily forested lands. Last winter you noticed a significant quantity of firewood being transported in pickup trucks and small trailers. Additionally, there were numerous advertisements in the local paper noting "firewood for sale."

We recommend the following procedure to determine the feasibility of entering the firewood business on a commercial scale.

Step I. Assess the market

From the local Chamber of Commerce you determine that your town has about 50,000 households. By conducting a phone survey, you learn that 25 percent or 12,500 homes burn wood in one form or another, and that each household uses an average of 1-1/2 cords per year. The total wood market amounts to 18,750 cords annually, of which 32 percent or 6,000 cords are purchased. All wood sold commercially is handled through wood dealers, nurseries, or lumber yards with the average retail outlet merchandising about 500 cords per year. Retailers are currently obtaining wood as far away as 175 miles. Most wood is not produced locally.

Step II. Assess raw material availability

Forests indigenous to the area are a combination of northern and central hardwoods. Red oak is found in large quantities. It is often high quality, and much of it finds its way to the export market. Red oak sawtimber stands are heavily sought for use as railroad ties, yet there really is no market for pulpwood-size material. Contacts with local loggers indicate that you would be able to obtain red oak firewood-size material for $35 per cord in lengths of 9 feet 10 inches delivered to your site.

Step III. Estimate production capability

There is a tendency to overestimate production, so it is wise to estimate it at more than one level, and to develop economic data for each level. For purposes of this example, we chose red oak. Red oak was processed at each firm studied; a total of 346 oak logs were timed. Estimates of production rates are always subject to criticism. We chose three levels of production based on 15 percent nonproductive time even though all three firms had more than 15 percent. A production rate in cords per hour was calculated for three levels: high (I), average (II), and low (III). The high rate was from Company A, low from Company B, and average from all three firms.

Item	Level I	Level II	Level III
Cords per 8-hour day (15% downtime)	17.4	13.9	9.3
Annual production in cords 250 days per year (15% downtime)	4,350	3,475	2,325

Step IV. Estimate financial returns

An analysis to determine financial returns begins with establishing capital requirements for fixed assets, labor, and operating capital. It concludes with projections of annual operating statements and then discounts expected returns over the duration of the investment back to the present time. In this case, the investor has $50,000 to invest over a period of 7 years. Tables 9 and 10 itemize funds required for fixed assets and expected annual labor charges.

Table 11 projects cash needs for the first 21 months of the project. Monthly cash flows were calculated on sales income and log costs for Production Level I (4,350 cords/year). Log cost was based on $35 per cord and increased by 2 percent to $35.70 to account for loss to sawdust. The latter figure represents the net raw material cost per finished cord of split firewood. Sales of firewood were based on $75/cord f.o.b. plant, a realistic figure for oak in Minnesota. As Table 11 points out, sales are seasonal, with firewood being sold for 8 months a year. This forces the firm to maintain a rather healthy bank balance during those months when there are no receipts flowing into the company.

This situation would be even more critical at Production Levels II and III. Indirect costs include both variable and fixed overhead. Sales and costs in Table 11 remain identical throughout the 21-month period. We know inflation will raise wage rates and raw material costs. We assumed, however, that these costs will be passed onto the consumer in the form of higher firewood prices. We have, therefore, increased operating capital requirements from $88,712 to $101,000 to accommodate inflation until the plant is operating in the black. Table 11 does not show fluctuating receipts since it is customary to pay for firewood on a cash on delivery basis.

Table 12 estimates the annual operating statement at each production level. Fixed overhead charges represent a Small Business Administration loan guarantee of $157,000 at 15-1/2-percent interest, payable in equal monthly installments over 7 years. Note that at both Production Levels II and III the operation shows a net loss.

Table 13 determines whether or not the investment is financially feasible by discounting future revenues to present value. In this case, the alternative investment was a government bond yielding 11 percent annually. Since the net worth of the investment at the end of 7 years exceeded the initial $50,000 investment, processing firewood at Production Level I is financially feasible.

At Production Level I, a $50,000 investment is feasible when compared to yields on government paper; note, however, that the government security is risk free. How risk free firewood manufacturing is depends solely on the market and managing skills of the entrepreneur.

Table 1.--Log volume purchased, firewood production, and volume loss by company

Company	No. of logs	Volume purchased (cords)	Volume loss (cords)			Percent loss	Net firewood produced (cords)
			Saw-dust	Offal	Total		
Single splitter							
A	250	11.02	.22	.02	.25	2	10.77
Double splitter							
B	250	9.21	.18	.48	.66	7	8.55
C	250	10.55	.21	.54	.75	7	9.80

Table 2.--Log distribution by size, volume purchased, firewood production, and volume loss by diameter class

Diameter class	No. of logs	Volume purchased (cords)	Volume loss (cords)			Percent loss	Net firewood produced (cords)
			Sawdust	Offal	Total		
3	26	.27	.01	.01	.02	7.4	.26
4	82	1.16	.02	.05	.07	6.0	1.08
5	125	2.63	.05	.08	.13	4.9	2.50
6	122	3.54	.07	.13	.20	5.6	3.33
7	136	5.22	.10	.13	.23	4.4	4.98
8	101	5.07	.10	.15	.25	4.9	4.82
9	67	4.48	.09	.09	.18	4.0	4.30
10	43	3.27	.07	.11	.18	5.5	3.10
11	21	1.77	.04	.08	.12	6.8	1.65
12	11	1.14	.02	.09	.11	9.6	1.03
13	5	.61	.01	.02	.03	4.9	.58
16	1	.19	.01	.02	.03	15.8	.16
17	--	--	--	--	--	--	--
18	--	--	--	--	--	--	--
19	--	--	--	--	--	--	--
20	1	.26	.01	.00	.01	3.8	.25
All classes	750	30.78	.62	1.05	1.67	5.43	29.12

Table 3.--Actual production rates of bulk firewood, by company

Company	Net firewood produced (cords)	Total processing time (hours)	Production (cords)	
			Per hour	Per 8-hour shift
Single splitter				
A	10.77	6.62	1.63	13.04
Double splitter				
B	8.55	10.08	.85	6.80
C	9.80	6.50	1.51	12.08

Table 4.--Percentages of nonproductive time by category and company

Time item	Company A	Company B	Company C
	percent of total study time[a/]		
Total study time	100	100	100
Productive time	64	63	60
Total nonproductive time	36	37	40
Personal activity	6	0	5
Work not in bucking cycle	21	29	0
Equipment breakdown	0	3	11
Equipment maintenance	5	1	12
Product jam	2	1	6
Wait for product	3	3	5
Wait for instructions	0	0	2

[a/] Sum of parts may not equal total due to rounding.

Table 5.--Total volume of firewood used during the 1978-79 heating season, by user class

Market area	Class 1[a/]	Class 2[a/]	Class 3[a/]	Class 4[a/]	Total
Minneapolis-St. Paul					
Number of households	9,345	33,877	75,930	37,965	157,117
Cords used	50,463	67,754	45,558	64,541	228,316
Cords/household	5.4	2.0	.6	1.7	1.45
% of total volume	22	30	20	28	100
Baltimore-Washington					
Number of households	20,046	76,843	113,594	153,687	364,170
Cords used	43,433	160,368	73,502	240,554	517,857
Cords/household	2.2	2.1	.6	1.6	1.42
% of total volume	8	31	14	47	100

[a/] Class 1 = Major source; Class 2 = Secondary source; Class 3 = Esthetic; Class 4 = Secondary and esthetic.

Table 6.--Firewood volumes purchased and cut by consumer during the 1978-79 heating season, by user class

Market area	Class 1	Class 2	Class 3	Class 4	Total
Minneapolis-St. Paul					
Volume cut by consumer	47,435	57,591	23,235	36,143	164,404
Volume purchased	3,028	10,163	22,323	28,398	63,912
Percent purchased	6	15	49	44	28
Baltimore-Washington					
Volume cut by consumer	39,958	100,905	41,896	180,416	363,175
Volume purchased	3,475	59,463	31,606	60,138	154,682
Percent purchased	8	32	43	25	30

Table 7.--Firewood species preferred during the 1978-79 heating season, by percent of total volume used

Species	Minneapolis-St. Paul	Baltimore-Washington
Maple	3	6
Oak	31	36
Birch	17	2
Elm	6	1
Ash	2	0
Aspen	2	0
Tamarack	1	0
Pine	1	6
Spruce	0	2
Mixed hardwood	37	47

Table 8.--Projected demand for firewood by 1981-82 heating season

Market area	Households installing wood-burning appliance by 1981			Total usage 1978-79	Additional usage by 1981-82	Total
	Fireplace	Stove	Furnace			
	--------number----------			----------thousand cords----------		
Minneapolis-St. Paul	1,168	5,840	2,336	228	25	253
Baltimore-Washington	--	10,036	--	518	21	539

Table 9.--Capital requirements for a firewood manufacturing plant

Item	Expected life (years)	Installed cost	Annual depreciation[a/]
		----------dollars----------	
Land (5 acres)	0	7,000	0
Improvements	0	5,000	0
Pole building	20	20,000	1,000
Single splitter processor	5	42,000	8,400
Skid steer lift with fork and bucket	5	18,000	3,600
Miscellaneous tools and equipment	1	5,000	5,000
Contingency	0	9,000	0
Total		106,000	16,000

[a/] Straight line depreciation used. Investors may choose double declining balance or other accelerated methods to reduce tax liability.

Table 10.--Capital requirements for labor (8 hours/day, 250 days/year)

Position	Annual salary	Payroll taxes[a/]	Total compensation
	dollars		
Administrative			
Owner-manager	20,000	3,198	23,198
Direct labor			
Sawyer	10,000	1,599	11,519
Yard man	9,000	1,439	10,439
Splitter	8,000	1,279	9,279
Total	47,000	7,515	54,515

[a/] Minnesota Statutes apply: Social Security, 6.13 percent; unemployment compensation insurance, 2.4 percent; workman's compensation insurance, 7.46 percent.

Table 11.--Projected cash flows required for first 21 months of operation--Production Level I (4,350 cords/year)

Month	1	2	3	4	5	6	7
Production (%)	50	100	100	100	100	100	100
Sales (dollars)	--	--	--	--	40,781	40,781	40,781
Less logs	12,941	12,941	12,941	12,941	12,941	12,941	12,941
wages	4,543	4,543	4,543	4,543	4,543	4,543	4,543
indirect costs	4,694	4,694	4,694	4,694	4,694	4,694	4,694
	22,178	22,178	22,178	22,178	22,178	22,178	22,178
Operating profit	(22,178)	(22,178)	(22,178)	(22,178)	18,603	18,603	18,603
Cumulative profit	(22,178)	(44,356)	(66,534)	(88,712)	(70,109)	(51,506)	(32,909)

Month	8	9	10	11	12	13	14
Production (%)	100	100	100	100	100	100	100
Sales (dollars)	40,781	40,781	40,781	40,781	40,781	--	--
Less logs	12,941	12,941	12,941	12,941	12,941	12,941	12,941
wages	4,543	4,543	4,543	4,543	4,543	4,543	4,543
indirect costs	4,694	4,694	4,694	4,694	4,694	4,694	4,694
	22,178	22,178	22,178	22,178	22,178	22,178	22,178
Operating profit	18,603	18,603	18,603	18,603	18,603	(22,178)	(22,178)
Cumulative profit	(14,300)	4,303	22,906	41,509	60,112	37,934	15,756

Month	15	16	17	18	19	20	21
Production (%)	100	100	100	100	100	100	100
Sales (dollars)	--	--	40,781	40,781	40.781	40,781	40,781
Less logs	12,941	12,941	12,941	12,941	12,941	12,941	12,941
wages	4,543	4,543	4,543	4,543	4,543	4,543	4,543
indirect costs	4,694	4,694	4,694	4,694	4,694	4,694	4,694
	22,178	22,178	22,178	22,178	22,178	22,178	22,178
Operating profit	(22,178)	(22,178)	18,603	18,603	18,603	18,603	18,603
Cumulative profit	(6,422)	(28,600)	(9,997)	8,606	27,209	45,812	64,414

Table 12.--Projected annual operating statement after start up for each production level

Entry	Production level I 4,350 cords/year	II 3,475 cords/year	III 2,325 cords/year
	dollars		
Sales at $75/cord f.o.b. plant	326,250	260,625	174,375
Cost of goods sold			
Raw material	155,295	124,057	83,003
Discounts and bad debt reserve	19,575	15,637	10,462
Gross profit on sales	151,380	120,931	80,910
Operating expenses			
Administrative	23,198	23,198	23,198
Direct labor	31,317	31,317	31,317
Depreciation	11,000	11,000	11,000
Overhead[a/] (Variable)	23,000	23,000	23,000
(Fixed)	38,330	38,330	38,330
Total	126,845	126,845	126,845
Net income before taxes	24,535	(5,914)	(45,935)
Net income after taxes	12,758		
Net after tax return on fixed assets	12%		

a/ Variable overhead computed from company records. Fixed overhead represents a bank loan of $157,000 at 15-1/2-percent interest over 7 years. Investor equity of $50,000 makes a total investment of $207,000: $106,000 for equipment and $101,000 operating.

Table 13.--Annual cash flows discounted to present--Production Level I

Year	Outflow	Net after tax revenue	Future revenue discounted to present at 11 percent[a/]	Net worth
	dollars			
Present	50,000	---	---	- 50,000
1	---	12,758	11,493	+ 11,493
2	---	12,758	10,354	+ 21,847
3	---	12,758	9,328	+ 31,175
4	---	12,758	8,404	+ 39,579
5	---	12,758	7,571	+ 47,150
6	---	12,758	6,820	+ 53,970
7	---	12,758	6,145	+ 60,115[b/]

[a/] Selected as the discount rate since an 11-percent yield was available for 7 years by purchasing Federal Home Loan Bank bonds (December 1979).

[b/] Represents the discounted future net worth of the investment. Since it exceeds $50,000, the investment yields a higher return than 7-year government bonds.

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